ARI NEWSLETTER

U.S. Army Research Institute for the Behavioral and Social Sciences

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A SOFTWARE TOOL FOR PREDICTING LIVE-FIRE PERFAORMANCE FROM DEVICE-BASED PERFORMANCE[1]

Using devices to predict live-fire performance and cut the cost of soldier training and evaluation.

In the Spring 1998 Newsletter, we proposed a strategy for enabling Army National Guard (ARNG) armor unit trainers to complete the device-based portion of their tank gunnery training program in just three drill weekends. Trainers could then predict which of their crews would be 1st-run qualifiers on Tank Table VIII (TTVIII). What made this strategy work was a look-up table that predicted TTVIII gunnery scores from those fired on a training device called the Conduct-of-Fire Trainer (COFT).

Recently, the ARNG asked us to go a step farther by giving unit trainers the capability to develop their own look-up prediction tables for devices besides COFT, and live-fire evaluation events as well as TTVIII. In response to this request, we developed an easy-to-use tool that provides this added capability.

THE TOOL

The tool is a software program designed to run in a Windows 3.1 or 95/98 environment. It can calculate predictions for any live-fire evaluation event that is simulated on a training device, provided the same scoring procedure is applied to each. Once the device and live-fire scores are entered, the tool automatically calculates the desired predictions with the click of a button and saves them for future reference.

HOW DOES IT WORK?

The steps needed to create, view, interpret, and use the tool's predictions are listed under the main menu options shown in Figure 1. One simply clicks on the desired option to enter or obtain the information requested. It's that easy.

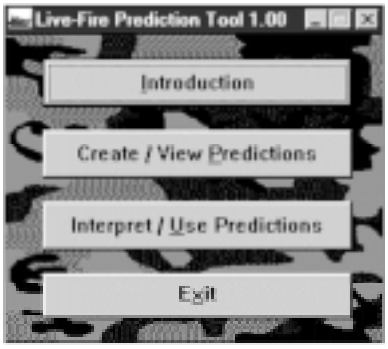

Figure 1

Clicking on the "Introduction" button provides (a) guidance on the kinds of device and live-fire data

[1] From Hagman, J. D. (1998, September-October). You asked, we listened: A software tool for predicting live-fire scores from device-based scores, Armor, CVII(5), 28-29.

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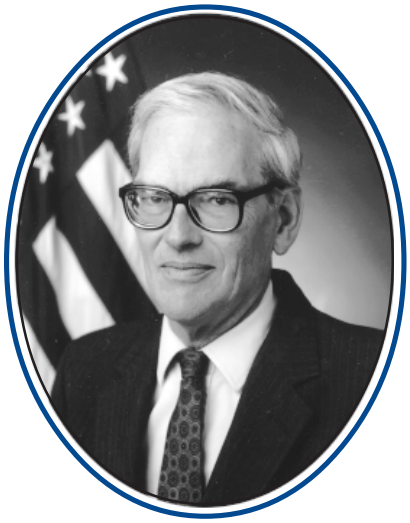


Director's Message

Timely and proper use of ever-increasing information resources is key to successful mission accomplishment at all levels, whether the mission is one of training or of actual operations. The lead article in this Newsletter describes software designed to enable unit trainers to predict live-fire performance on training devices. This capability is particularly valuable in the decentralized Reserve environment.

The articles on training evaluation and "thinking like a commander" both involve selection and use of relevant information. Training evaluation, again, deals with device-based training. The challenge in this case is to provide training evaluation elements that yield accurate conclusions as to the effectiveness of training devices. Thinking like a commander emphasizes the "how" as opposed to the "what" for thinking skills, and the practice techniques required to build these skills.

The concept of "tacit knowledge" has been applied to the specific Army problem of driver safety, as described in another article. In this case, the challenge is to get people to access information they already know, but may not "know they know".

Finally, we present thirteen issues having to do with contingency operations, derived from attitude and opinion studies. This is a good example of data on some highly "subjective" topics (motivation and morale) being translated into practical recommendations for leaders.

In all of these cases, a common theme is one of systematically defining and extracting needed data from an often-confusing array of information. Our research provides various Army leaders and trainers with the tools they need to accomplish this, thus bridging the gap between basic learning and training principles and practical application to "real-world" challenges.

that need to be collected and then entered, (b) tips on how to collect these data for best results, and (c) helpful hints on how to navigate successfully through the program. Clicking on the "Create/View" button leads to the "Prediction Log" screen, shown in Figure 2, where results are stored for permanent access.

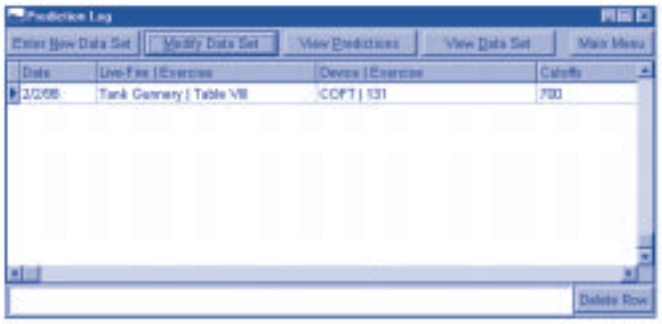


Figure 2

Clicking on the "Prediction Log" screen's "Enter New Data Set" button leads to the "Enter Scores" screen, shown in Figure 3, where the collected device and live-fire data, as well as supplemental information needed for data set identification, are entered. Identifying information includes the category of live fire to be predicted (e.g., tank gunnery, rifle marksmanship), the live-fire event scores to be predicted (e.g., TTVIII, record fire), the training device used for prediction (e.g., COFT, Engagement Skills Trainer[EST]), the device exercise scores from which predictions will be based (e.g., COFT advanced matrix exercise 131, EST simulated record fire exercise), the cutoff score(s) against which predictions will be calculated (e.g., 700 for TTVIII qualification, 26 for record fire qualification), the maximum possible live-fire score (e.g., 1,000 on TTVIII, 40 on record fire), and specific unit/ range information.

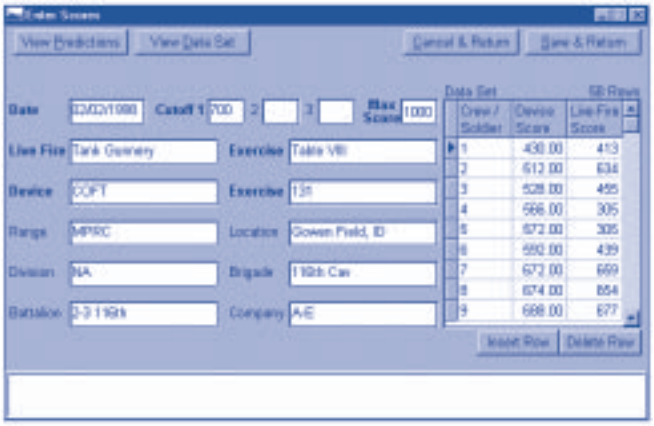


Figure 3

Once data entry is complete, clicking on the "View Predictions" button displays the desired predictions in tabular format like that shown in Table 1 for TTVIII gunnery. Column 1 shows a range of possible devices (i.e., COFT) scores. Column 2 shows the predicted average live-fire score for each device score listed. Column 3 shows the predicted 1st-run chances of firing at or above the live-fire cutoff score (i.e., 700) entered earlier for TTVIII qualification.

Date: 2/2/98 Division: N/A
Range: MPRC Brigade: 116th Cav
Location: Gowen Field, ID Battalion: 2-3 116th
Company: A-E

Predictions of 1st-Run Live-Fire Scores on Tank Gunnery / Table VIII From Device-Based Scores on COFT / Exercise 131

Device Score	Predicted Average Live-Fire Score	Chances (%) of a Live-Fire Score ≥ 700
541	543	10
616	595	20
674	636	30
721	669	40
765	700	50
809	731	60
856	764	70
914	805	80
989	857	90

Table 1

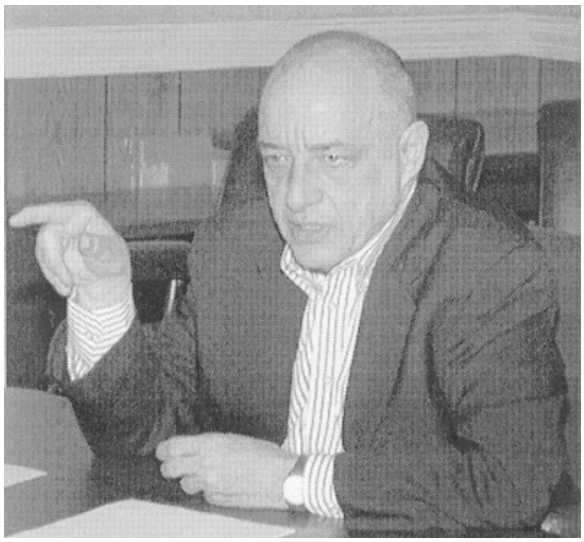
Lastly, clicking on the main menu's "Interpret/Use Predictions" button provides guidance on how to do just that for the predictions provided. Using the sample prediction table shown in Table 1, for instance, it would be predicted that a tank crew with a COFT score of 765 will on the average fire 700 on TTVIII and have a 50% chance of successful 1st-run qualification. A tank crew with a COFT score of 856 will on the average fire 764 and have a 70% chance of successful 1st-run qualification, and so forth.

WHAT'S THE PAYOFF

The resulting predictions now allow ARNG unit trainers to do things they haven't been able to do before. First they can predict soldier/crew, 1st-run, live-fire performance on their range(s) from performance obtained on their device(s). Second they can schedule device-based training more efficiently by targeting only those soldiers/crews in need of remediation (i.e., those not meeting the device-based live-fire expectancy standard [e.g., 70%] set by the unit commander for 1st-run qualification). Third, they can identify when their soldiers/crews have received enough device-based training (i.e., when they've met this expectancy standard). And lastly, they can save ammunition by allowing only those soldiers/crews ready for successful live-fire evaluation to proceed to the range.

Although we've developed the prediction tool for use by the ARNG, Active Component (AC) unit trainers might find it useful as well. In the months to come, we'll be conducting the research needed to assess the validity of this notion. In the meantime the interested reader can download a copy of the prediction tool software program off ARI's website @www-ari.army.mil by clicking on "Highlights" and then on "Predicting Live-Fire Performance."

For additional information, contact Dr. J.D. Hagman, ARI-Reserve Component Training Research Unit, Commercial (208) 334-9390. hagman@ari.army.mil



Dr. Charles Moskos, presenting initial findings of research working a number of issues with various HQDA elements and DoD organizations.

The S.L.A. Marshall Chair

Dr. Charles Moskos is professor of sociology at Northwestern University in Evanston, Illinois. He is a leading figure in military sociology. His most recent book, "All We Can Be: Black Leadership and Racial Integration the Army Way," examines race relations in the military.

Dr. Moskos occupies the S.L.A. Marshall 1999 Research Chair at ARI. The Chair was established to build bridges between the military research community and the academic world. The S.L.A. Marshall Research Chair symbolizes the importance of the human dimension into the systematic consideration of military effectiveness.

Leaders' Guide for Contingency Operations: The Human Dimension

Results from ARI research on soldier attitudes and opinions with respect to their experiences in contingency operations have been compiled into a guide for leaders on issues affecting soldier motivation and morale during contingency operations.

ARI research of the attitudes and opinions of soldiers deployed for contingency operations identified recurring issues that emerge during contingency operations and impact on soldier motivation and morale. These issues and associated recommendations are presented in a guide for leaders to use both prior to and during contingency operations.

The guide is designed to help leaders prepare their units before the deployment and address issues that arise during the deployment. It also can be used by leaders in officer and NCO professional development conducted at the unit, and in self-development. It is organized around the following 13 issues:

- Mission Clarity
- Situation Stability
- Amount of Threat/Lethality
- Complexity of the Force
- Complexity of the Environment
- Specificity of Advanced Preparation
- Duration of Deployment
- Media Visibility
- Range of Job Tasks
- Quality of Leadership
- Quality of Life
- Amount of Family Support
- Quality of Rear Detachment

Each of these issues is discussed very briefly below.

THE ISSUES

Mission Clarity - The degree of mission clarity, both prior to and during the operation, impacts the extent to which soldiers and leaders question their participation in the mission. In addition to providing soldiers with a broad framework for understanding the operation, leaders need to tell soldiers how the specific tasks and details they are performing during the operation contribute to overall mission success. Also, leaders need to provide soldiers with an opportunity to see the improvements that have resulted from the Army's presence.

Situation Stability - Situation stability and predictability, both within and across contingency operations, impact readiness and soldier attitudes toward the mission. Changes in stability and predictability require renewed effort on the part of leaders to maintain soldier and family support for the mission. Leaders need to anticipate soldier resistance to change and recognize that providing reasons for the change will help overcome their resistance.

Amount of Threat/Lethality - Perceptions of the amount of threat and lethality affect soldier and family concerns about the mission. Soldier perceptions of the threat also affect their attitudes toward force protection rules, rules of engagement, and the nature of the mission. It is important to address policies in these areas prior to deployment, particularly when they differ from those in garrison or from previous deployments. Throughout the deployment, leaders need to identify and address soldier concerns regarding force protection rules and tactical security.

Complexity of the Force - Contingency operations challenge soldiers and leaders to coordinate and interact with a complex military force that differs from operation to operation. This force may include

personnel from different types of units, different Army components, other U. S. services, and militaries from other countries. Leaders need to use liaisons or individuals familiar with other services or militaries to facilitate coordination and cooperation. Currently deployed units need to provide their replacement units with the lessons they learned about interacting with a complex force. AC and RC soldiers and leaders should be required to demonstrate and encourage mutual respect between the components in theater and at backfill locations.

Complexity of the Environment - Contingency operations challenge soldiers and leaders to interact in a complex environment that differs from operation to operation. Soldiers and leaders may be required to interact with non-government organizations, contractors, formerly warring factions, local police forces, and local community leaders. Recommendations are to: train leaders to recognize when it is and is not appropriate for them to interact with the local population; use liaisons to help interpret the reactions of the local population; and recognize that approaches that work in the environment of one operation will not necessarily work in the environment of another.

Specificity of Advanced Preparation - The specificity and realism of advanced preparation impacts soldier assessments of the adequacy of pre-deployment preparation and training. Soldiers especially value mission-specific, scenario-driven training shortly before deployment and written materials on the area to which they will deploy (e.g., on history, terrain, climate, culture). Not only do logistical plans need to be worked out in advance — especially for the first few weeks — but they need to be communicated to soldiers, as well.

Duration of Deployment - The duration of deployment impacts soldier satisfaction. Soldiers' perceptions about the length of the deployment are

U.S. Forces in Haiti

based on much more than just the number of months of the current deployment. Some other factors they consider are: duration and frequency of their previous deployments; the length of their deployment compared to that of other military personnel; and the purpose of the deployment. Leaders need to help soldiers understand the factors that determine deployment length and provide them with a realistic estimate of the length of the deployment. Leaders also should let soldiers know that the exact date of redeployment may not be known in advance. Finally, they also should control rumors regarding changes in length of deployment and the redeployment date.

Media Visibility - The amount and favorability of media coverage of contingency operations affect soldier and family attitudes. Problems can arise when soldiers perceive too much or too little media coverage. Recommendations are to: prepare leaders and soldiers for talking with the media; develop unit procedures for providing the media with access to information; monitor relevant information provided by the media; and be prepared to address soldier concerns that may arise.

Range of Job Tasks - The types of job tasks soldiers and leaders are required to perform during contingency operations affect acceptance of their individual participation in the mission. Prior to the deployment, leaders need to prepare units and soldiers for the additional mission tasks that the soldiers will have to perform, such as guard duty. Even with advance preparation, soldiers often question during the operation why they are required to perform certain jobs and tasks. Leaders need to provide a framework that shows soldiers how their assigned tasks are consistent with and contribute to overall mission success. Tasks assigned to soldiers should be meaningful and not busywork.

Quality of Leadership - Quality of leadership affects soldier morale and attitudes toward the operation and the Army as a whole. The quality of leadership has been judged more critically by soldiers during contingency operations than in garrison. Communication both up and down the chain needs to be strengthened to help soldiers understand the rationale for leader actions and to increase leader awareness of soldier concerns. When possible, provide soldiers with the rationale for leader decisions and actions. Leaders should always demonstrate Army values.

Quality of Life - The quality of life during contingency operations impacts soldier satisfaction and attitudes toward the Army. Soldiers assess their quality of life with respect to treatment, policies, and amenities provided. Their assessments are based not only on actual conditions, but on their expectations and on comparisons with others in the current operation. Prior to deployment, leaders need to communicate R&R and leave policies, including differences between policies for the current and other deployments and differences between downrange and garrison. During the deployment, leaders need to minimize inequities and be ready to address any differences across groups in quality of life.

Amount of Family Support - The amount of family support for the mission and the Army affects soldier morale. Family support is a function of many factors including understanding of the mission; perceived level of danger to the soldiers; perception of Army support for families during deployment; amount and accuracy of information families receive about the mission and the soldiers; and ease and availability of communication with soldiers. Leaders need to communicate to families and soldiers the importance of the mission and measures taken to ensure soldier safety. In addition, leaders need to communicate to soldiers the resources available to their families and to encourage spouse participation in family support groups.

Quality of Rear Detachment - The perceived quality of the rear detachment affects unit and soldier morale. Leaders need to clarify the role of the rear detachment for both soldiers and families. They need to recognize the importance of the rear detachment and assign a competent commander.

CONCLUSIONS

Together, the issues and the recommendations presented in the guide represent leadership lessons learned that can be used both before and during contingency operations. Before an operation, these

lessons serve as a tool for effectively preparing leaders and soldiers for the mission. During the operation, these lessons serve as a reference guide and reminder of important factors leaders need to address.

Two themes are evident throughout the guide. The first is the need to anticipate and adapt to changes. Viewing the issues presented in the guide as dimensions that can vary on a continuum, both from operation to operation and within a given operation, can help reinforce the need to anticipate change. When soldiers expect change, they are more likely to accept, prepare, and adapt to it.

Quality of life during contingency operations impacts soldier satisfaction and attitudes.

The second theme is the need for more and better communication. Leaders need to recognize and to take into account that the frame of reference of subordinate leaders and soldiers may differ from their own. Keeping this in mind will help leaders to recognize the need to increase the information flow to soldiers, particularly with respect to the issues addressed in the guide.

For additonal information or to receive a copy of the *Leaders' Guide for Contingency Operations: The Human Dimension*, contact Dr. Alma Steinberg, ARI-Cheif, Army Trends Analysis Group, DSN 767-0364 or Commercial (703) 617-0364.
steinberg@ari.army.mil

The Elements of Training Evaluation

Failure to incorporate "The Elements of Training-Evaluation" leads to erroneously concluding new training and conventional training are equally effective.

Evaluating training is conceptually a simple matter. Involving comparisons between the proficiency of soldiers or units using conventional or field training on the one hand, and the proficiency of soldiers or units using new (usually device-based) training on the other. In practice, however, this conceptually simple matter presents technical and logistic threats that always limit and often preclude valid inferences about training effectiveness. ARI described the threats and recommended countermeasures in a report on lessons learned from reviewing training-effectiveness evaluations of Simulation Networking (SIMNET). Chief among the findings in that report was that "In empirical evaluations of SIMNET . . . compromises were so severe that they precluded valid inferences about the effects of SIMNET training on soldiers' performance in the field." Remedying this problem, requires redefining training evaluation in terms of ongoing processes rather than as isolated events, and establishing a continuous TQM-like system to support new training in ways similar to the ways the Center for Army Lessons Learned supports the Combat Training Centers. Under TRADOC leadership, ARI and other organizations are now planning such a system.

On reading the lessons-learned report summarized above, Deputy Undersecretary of the Army (Operations Research) urged ARI to commit scientists to assist the Operational Evaluation Command (OEC) and the PM CATT in planning field trials for the Close Combat Tactical Trainer (CCTT). ARI supplied assistance as requested, and this resulted in recommendations for new training-evaluation designs and data-analysis methods, which we reported to the OEC and to the PM CATT. We also reported our recommendations (a) in an award-winning colloquium presentation, (b) at a NATO conference on modeling and simulation, and (c) in a journal of the American Psychological Association. In addition to expositions of new evaluation designs and analysis methods, those presentations contained empirical and logical evidence that training evaluators' widespread conclusions about "equal effectiveness" of conventional and new training are probably wrong. The authors also noted the effects of erroneous equal-effectiveness conclusions on readiness and the national defense, and warned that errors in Army evaluations of device-based training may have life-or-death consequences.

Largely as the result of publicity associated with the presentations and publications noted above, the U.S. Army Training and Doctrine Command's (TRADOC) Studies and Analysis Branch awarded a high priority to an ARI study proposal. Work on that study has produced draft chapters for a book and for a related TRADOC pamphlet. These materials present 15 training-evaluation "elements" with discussions of the necessity of each for making valid inferences about training effectiveness.

The chief consequence of failure to incorporate any of the elements into training evaluations is a high probability of erroneously concluding that new training and conventional training are equally effective, with potential consequences as noted earlier.

The Elements of Training Evaluation includes, in addition to expositions of the elements and of failures to include them in Army training evaluations, chapters on (a) scratch-pad calculations for estimating the validity of inferences from training-evaluation results, (b) transfer-of-training and training-efficiency

The Elements of Training-Evaluation

1. *Test alternatives to hypotheses about equal effectiveness of conventional and new training.*
2. *Specify the risk the evaluation customer is willing to take of erroneously concluding conventiona and new training are equally effective.*
3. *Perform power analyses to determine the number of observations necessary to detect true differences between the scores of compared groups.*
4. *Assign soldiers or units to the compared kinds of training randomly; if that is not possible, consider countermeasures presented here and acknowledge consequences of failure to employ them.*
5. *Establish that the compared groups do not differ significantly in ways that might affect outcomes.*
6. *Treat the compared groups identically during the evaluation in all respects except kinds of training.*
7. *The reliability of the posttests, that is, the tests administered after training the compared groups, must be at least 75%.*
8. *The difficulty of the posttests must permit few and preferably no scores greater than 75% or less than 25%.*
9. *Allow some time to pass between the end of training and the beginning of testing.*
10. *Administer more than one posttest.*
11. *The time between the end of training and the beginning of testing must be identical for the compared groups.*
12. *Use conventional analyses of raw scores to estimate training effects.*
13. *Perform separate analyses of training-sensitive and training-insensitive test items.*
14. *Interpret null results in terms of confidence intervals.*
15. *Report generalizability estimates.*

estimates, and (c) rebuttals of common rationalizations for compromised field trials. An updated draft of *The Elements* is scheduled to appear on TRADOC's web site during the first half of 1999. Readers' comments will, of course, be welcome.

For additonal information, contact Dr. John A. Boldovici, Simulator Systems Research Unit, DSN 970-3983 or Commercial (407) 970-3983. John_Boldovici@stricom.army.mil

Think Like a Commander

ARI is constructing a set of individual, computer supported, case-based exercises designed to help officers train themselves to develop good battlefield thinking habits. We are calling the set of exercises Think Like a Commander. Another important use of deliberate practice methodology is the Digital Leader's Reaction Course (DLRC).

For decades, the Soviet chess machine thoroughly dominated all competition. Chessplayers around the world assumed the Soviets achieved their success solely by extra effort in selecting, developing and supporting promising players. But did the Soviets have some new and secret training methods that the rest of the world did not? No, no one imagined that. With the breakup of the USSR, Soviet chess academies became publishing houses. The release of such books as Alexander Kotov's Think Like a Grandmaster and Mark Dvoretsky's Secrets of Chess Training, stunned the chess world,

A lesson from the Soviet Chess Machine

as it discovered that indeed the Soviets did have methods they had kept secret. Scientists at ARI have analyzed the Soviet methods and believe they are as applicable to military thinking on the battlefield as they are to thinking at the chessboard. They have advanced a theory of training that is being applied in several training developments including the Digital Leader's Reaction Course (DLRC), a project of the Command and General Staff College (CGSC) at Fort Leavenworth.

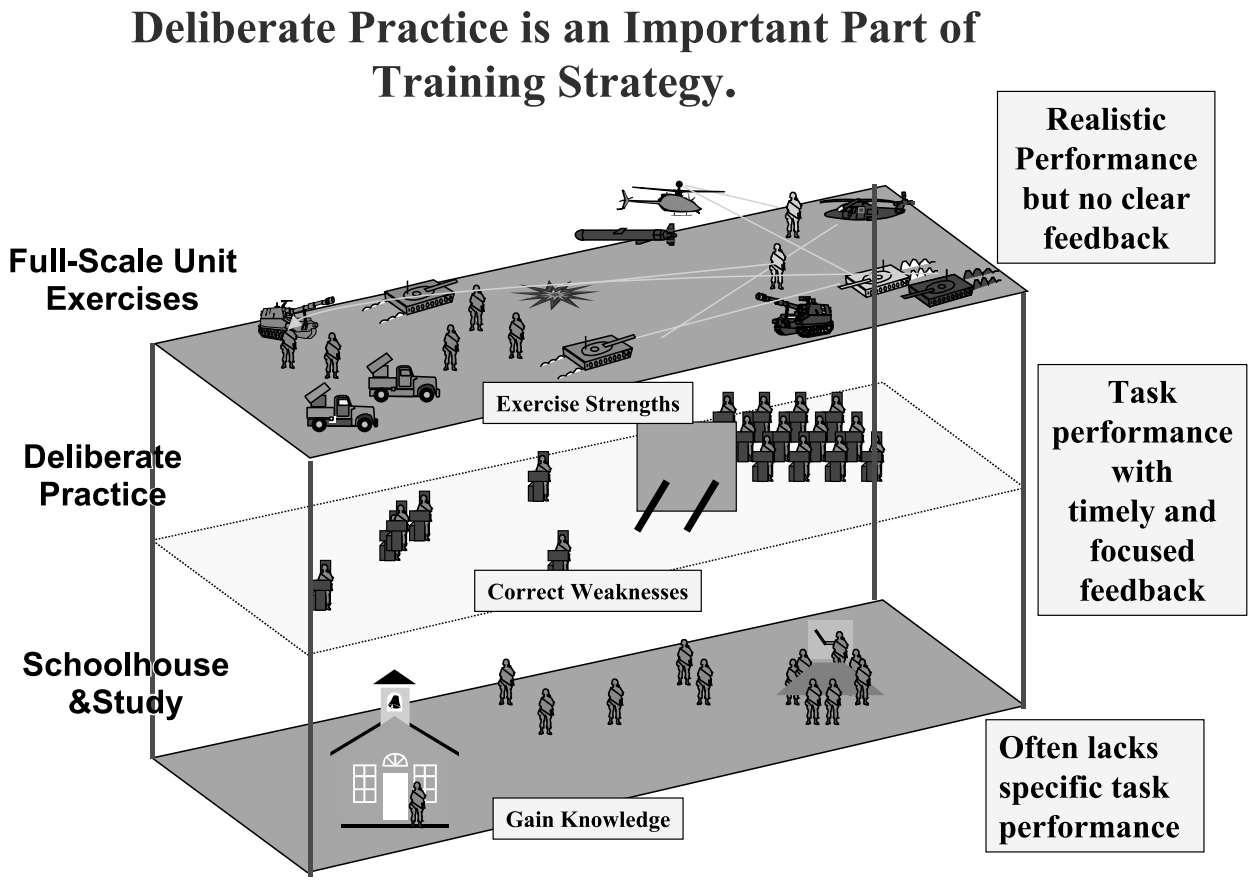
The key to the Soviet methods is that they trained the thinking processes of their students. The rest of the world studied the game of chess, its strategies and tactics, and tried to understand why one move was better than another. The Soviets did this as well, but also studied the human processes of finding good moves and avoiding errors, of searching and evaluating chess positions, and of controlling emotion and fighting the psychological battle with one's opponent. The Soviets described principles of expert play which reflected the thought patterns of grandmasters. While many of these expert principles were familiar to the rest of the world, the Soviet trainers went one critical step further. They created exercises that trained these principles, ingraining them in their students. The Soviet students employed the expert thought patterns not simply because they understood the principles nor because they were following a remembered checklist. The behaviors had become automatic. As a result of the exercises, the students followed the principles without thinking about them, freeing their limited conscious resources to focus on the novel aspects of the contest and to think more deeply and creatively at the board.

In one sense, it could be said that the Soviet trainers taught their students "how to think" about chess as opposed to "what to think". Certainly the players began to use their chess knowledge more facilely and effectively. But they did not teach them "how to think" in the sense that the exercises made them better thinkers in general, or raised either their IQs or their problem solving ability away from the chessboard. In a previous work ARI researchers led discussions among CGSC students as part of a course designed to introduce them to some general thinking skills, for example, "finding hidden assumptions" or "taking multiple perspectives." Two insights became apparent. First, merely discussing and illustrating the

concepts was not enough. Specific exercises were needed to allow the students to train themselves in the use of the techniques. Second, it became evident that the students, Field Grade Army officers, have a great deal of knowledge in the military domain but do not always use the knowledge effectively. This is especially true when they are thinking under the pressure of time, risk, complexity, and competing demands associated with actual military operations and realistic simulations such as at the Combat Training Centers.

So what were the exercises developed by the Soviets like? Surprisingly they were not something unknown in training theory. They were typical examples of what is termed deliberate practice by those who study the growth of world-class experts. Training of this sort is extremely common in sports, in learning to play musical instruments, in marksmanship and gunnery, and in a great variety of other fields. What was so innovative about the Soviet approach was the application of these methods to thinking behaviors as opposed to the coordinated sensorimotor behaviors (for example, hand-eye behavior) characteristic of sports. In the old Soviet Union, the chess trainers were part of the Ministry of Sport, which perhaps helped spur the innovation.

In deliberate practice there is isolation of a component behavior, performance, measurement, feedback, and a shaping of correct performance. Typically there is a focus on weaknesses as opposed to strengths. The final performance of the response in a correct form is vital because it is only through performance that the behavior becomes automatic and can be performed without conscious effort. Making a mistake, and later realizing that mistake, for example, during an AAR discussion, does not go far enough. Deliberate practice requires a repetition in which the correct behavior is performed.



Developing expertise can be viewed as a three-tiered process. In the bottom tier the officers learn to understand military concepts and their relationships. This is a knowledge acquisition process. In the second, deliberate practice tier, they develop skill in manipulating the concepts, that is, thinking with them. Under the action of directive feedback they correct weakness and strengthen component thinking skills. In the third tier they exercise what are now hopefully strengths and reinforce existing skills. All three tiers are important elements in the development of expertise.

In reading the Soviet chess training manuals, it is clear that they had identified chess-specific thought habits - completely analogous to elements of form in sport or music. In order to emulate their methods it is necessary to do the same for battle command. Several ARI studies have addressed this goal. In one study renowned tactical experts evaluated the planning and reasoning of a variety of military participants. The protocols of the planning sessions were analyzed to see what behaviors led to high ratings. Our initial cut is a list of seven habits that we have identified as characteristic of expert military practitioners and by the same token as not characteristic of beginners or those evaluated as less skilled. That initial set is:

- Model a **thinking** enemy.
- Keep a focus on **mission accomplishment** and **higher commander's intent.**
- Exhibit visualizations that are **dynamic, proactive, and flexible.**
- Show rich **contingency** thinking.
- Consider where your fight fits into **the bigger picture** of what is happening/should happen both from friendly and enemy perspectives.
- Consider **all elements/systems** available to you and your enemy and their interactions.
- Include considerations of **timing.**

These behaviors are familiar to most soldiers who have studied the art of battle command. Despite the familiarity of the ideas, the behaviors are commonly performed poorly or not at all in realistic situations, especially in times of stress, fatigue, and distracting demands. The commander encounters a minefield and does not consider the enemy's purpose in emplacing the minefield. (Where does he want me to go?) He changes his axis of advance and does not consider how this will effect adjacent friendly units. He reacts to an unexpected enemy threat and does not assess the affect of his reaction on mission accomplishment. He forecasts the actions of the enemy regiment he is facing without considering what role that regiment plays in the concept of the enemy division commander. He visualizes the movements of one of his companies through the attack without assessing the progressive effects of combat on the company's capabilities. It is not enough just to understand the concepts; it is necessary to perform the behaviors with enough repetition that they become habitual. Thinking itself should never become automatic and effortless but the structure of how to think on the battlefield, once it has become habitual, supports clear and accurate thinking under conditions of pressure.

At Fort Leavenworth, ARI is constructing a set of individual, computer supported, case-based exercises designed to help officers train themselves to develop good battlefield thinking habits. We are calling the set of exercises Think Like a Commander. Another important use of deliberate practice methodology at Leavenworth is the Digital Leader's Reaction Course (DLRC).

Deliberate practice methodology

The DLRC currently under development, is a major component of the Digital Leader's Development Center (DLDC). It is being built at Fort Leavenworth by the Center for Army Tactics (CTAC) with the support of many other activities including TRADOC via Army Experiment 5 and 6 (AE5 & AE6), the Battle Command Battle Lab, TRADOC Analysis Command, the CGSC School for Command Preparation, and ARI. The inaugural proof-of-principle tests were conducted in the summer of 1998.

In September 1998, the commander of 1/4ID and his TAC staff participated in a training exercise at Fort Leavenworth using the DLRC. They conducted three movement-to-contact exercises. The exercises were conducted with well-specified training objectives in mind (e.g. placement and control of artillery units). The exercises were kept short (90-150 minutes) and stopped after the critical decisions had been made. The after action review (AAR) ensued shortly and was kept brief. AARs focused on the training objectives, did not involve a rehash of the recently fought battle, and were well supported by automation. Then a similar, though not identical, iteration of the exercise with the same initial conditions and training objectives was conducted. This deliberate practice methodology allows commanders to improve decision making during execution.

In 1999 the development of the DLDC is continuing as the capability is being expanded to include brigade staffs. The staff trainer will be "COFT-like", a term which emphasizes the application of deliberate practice concepts used in gunnery trainers. The training concept is being developed by an AE6 group composed of three types of individuals: high-level tactical experts represented by retired general officers; experienced trainers, represented by active duty instructors from CGSC; and learning theorists, represented by scientists from ARI, ARL (Army Research Laboratory) and MITRE. Together this Army partnership will develop an institutional capability to support the deliberate practice tier of expert development.

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